

The Future of Ecosystems under Climate Change

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5th Annual
California
Climate
Change
Conf.



1. Our Rapidly Warming

CA State Insect:

World

CA Dogfaced
Butterfly



2. How Species Adapt



3. When Species Cannot Adapt

Upsala Glacier Argentina



1928



2004

Portage Glacier in Alaska

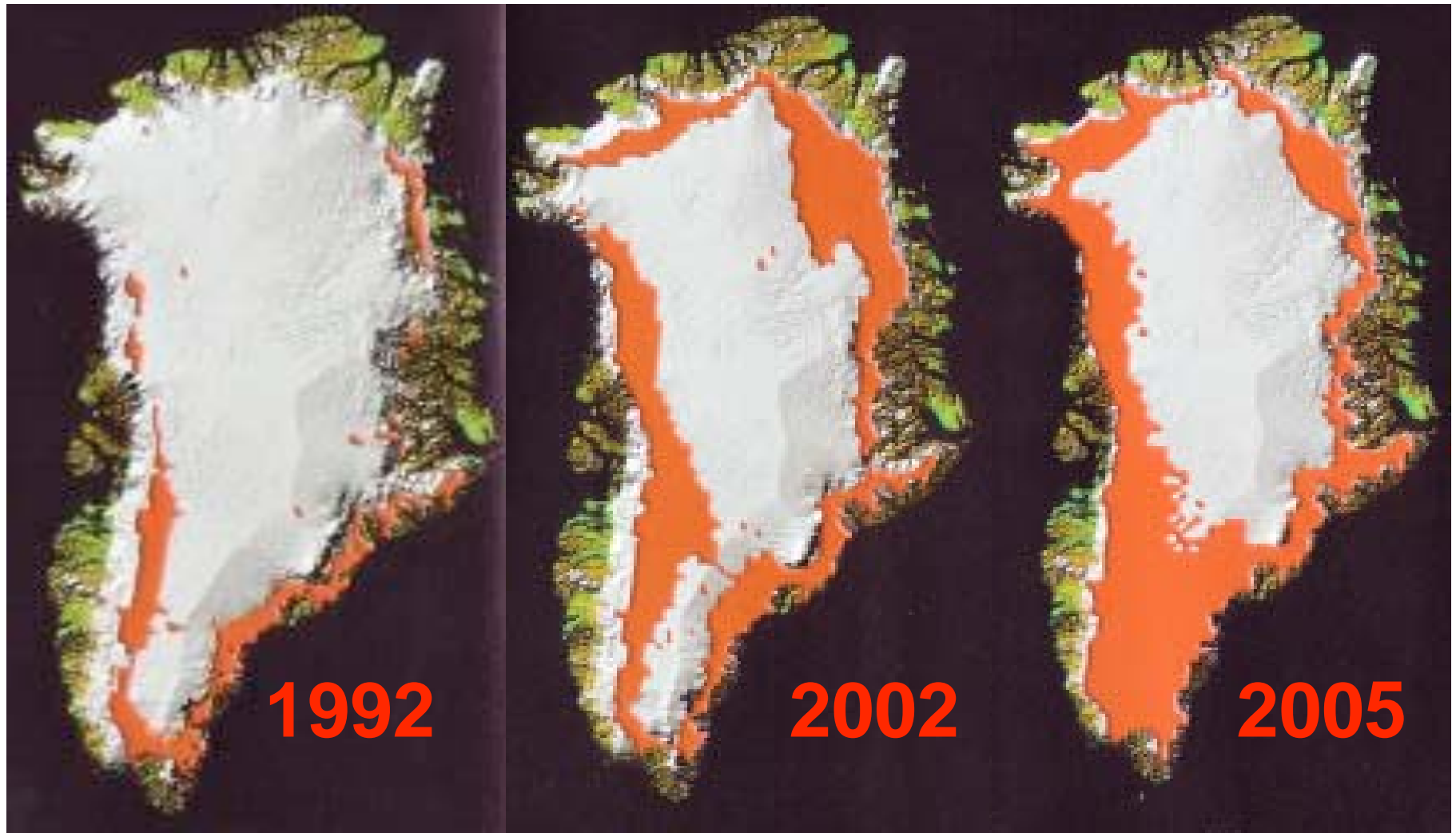


1914



2004

Ice on Greenland



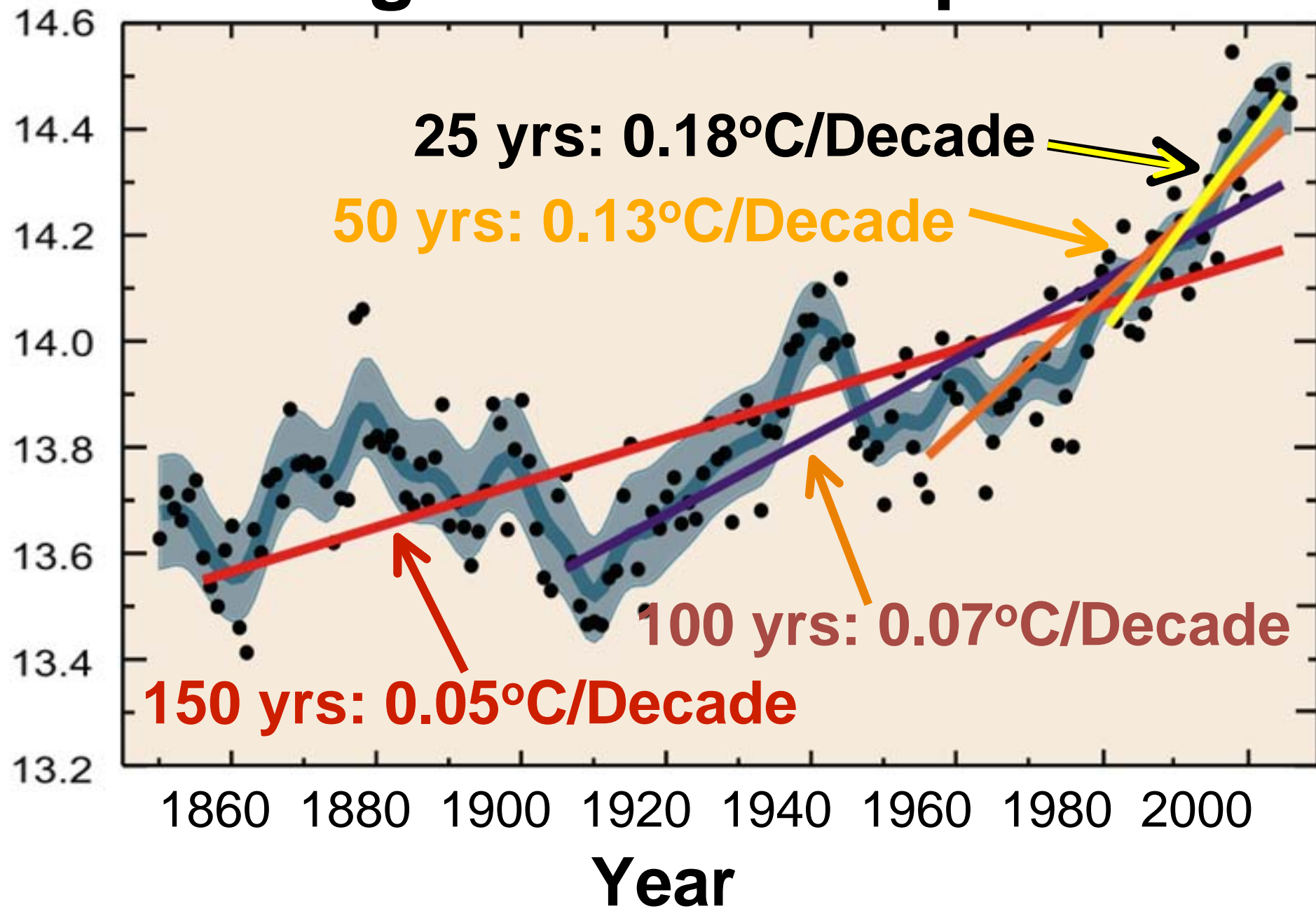
Source: ACIA, 2004 and CIRES, 2005



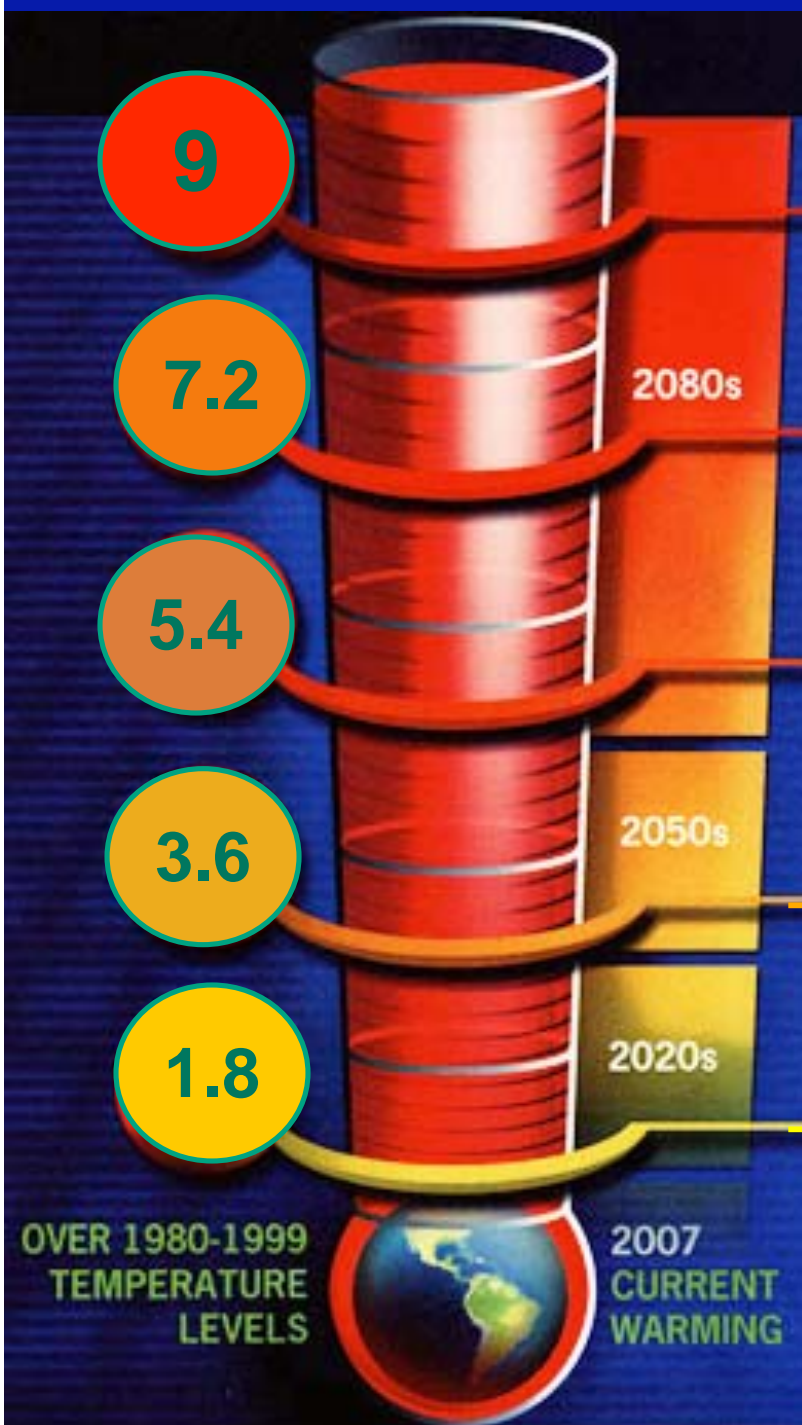




(°C) Average Global Temperature



Impacts of Global Warming



Extinction (>40% known sp),
partial melting ice sheets,
↑ sea level 13-20 feet

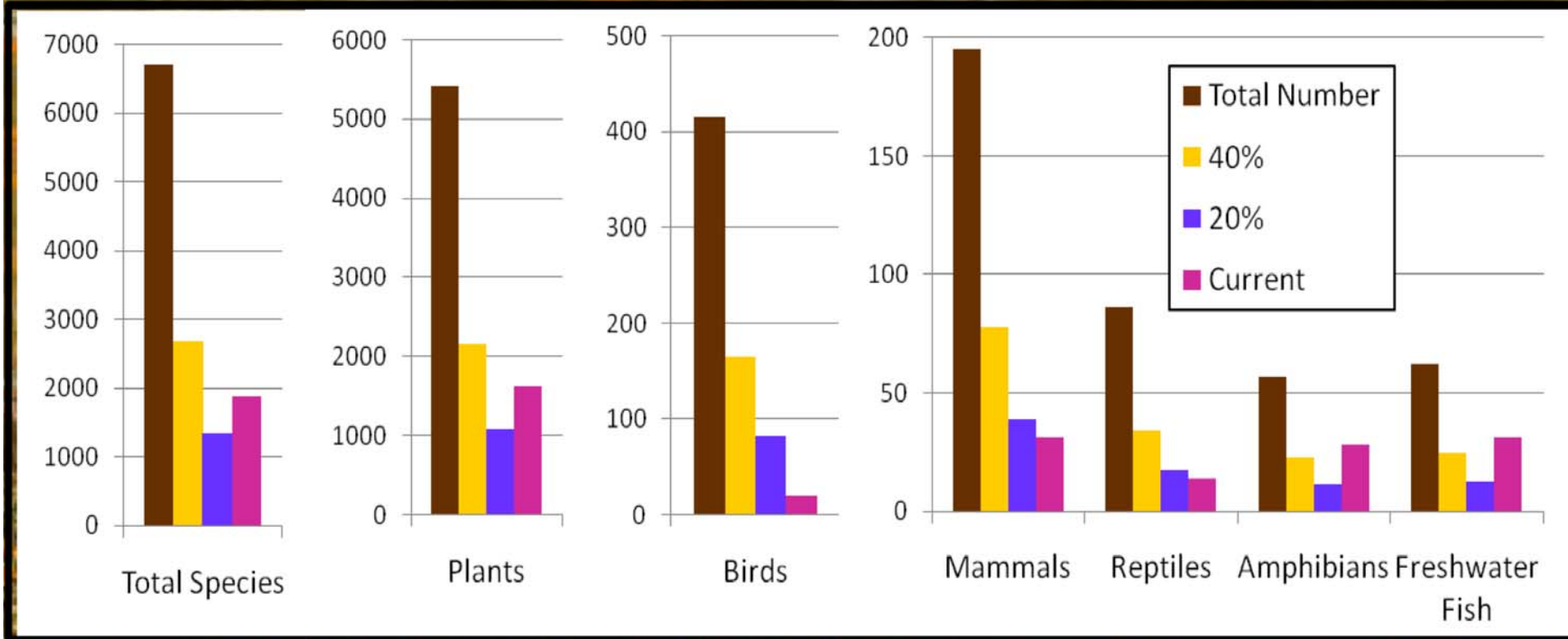
~30% of Global Wetlands lost,
↓ Global Food Production

Major Changes in Natural Systems:
↓ Biodiversity, Coral Mortality

↑ Risk Extinction (20-30% known sp),
Most Coral Bleach, ↑ Flood+Drought

} ↑ 0.6°F

↑ Water, ↑ Drought, ↑ Fire Risk,
↑ Flood/Storm Damage www.net.org



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World



**2. How Species
Adapt**



3. When Species
Cannot Adapt

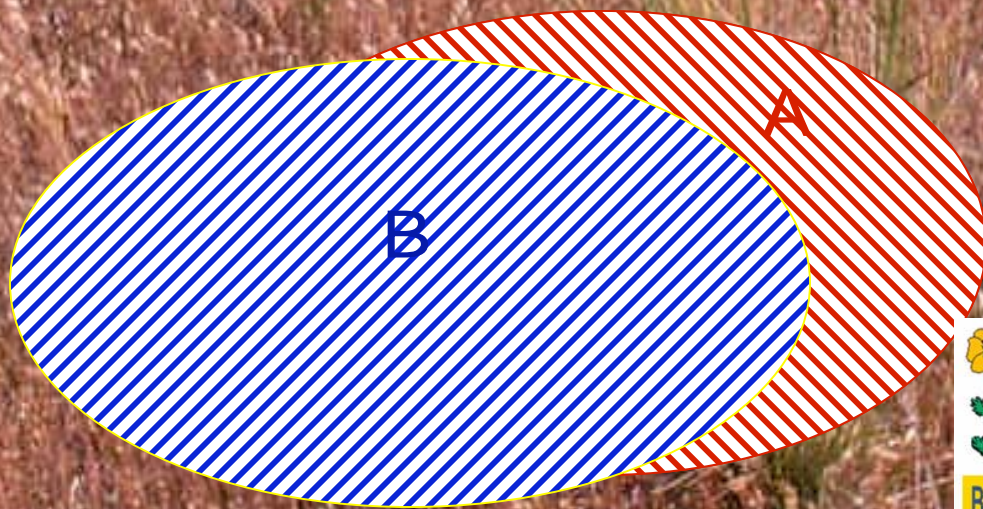
Type of Changes

- ◆ **Range Shifts:**
 - ◆ **Poleward**
 - ◆ **Up in Elevation**

CA State Tree:
California Redwood

CA Grass: Purpleneedle Grass

↑ N



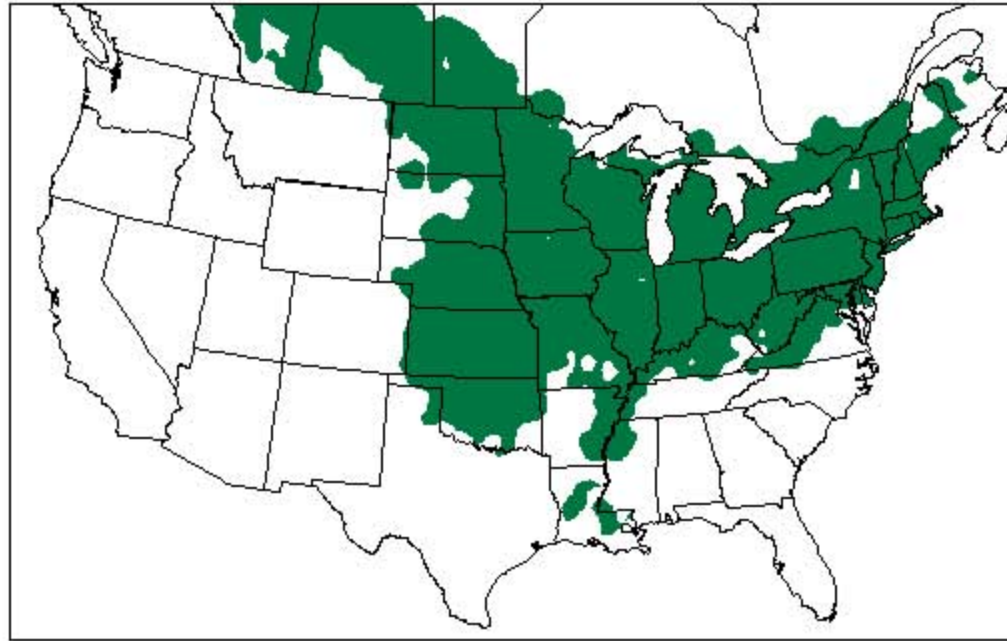
Western Pine Beetle Damage





Source: National Geographic 4.2004

Current Distribution



Baltimore Oriole

Projected Distribution (2xCO₂)



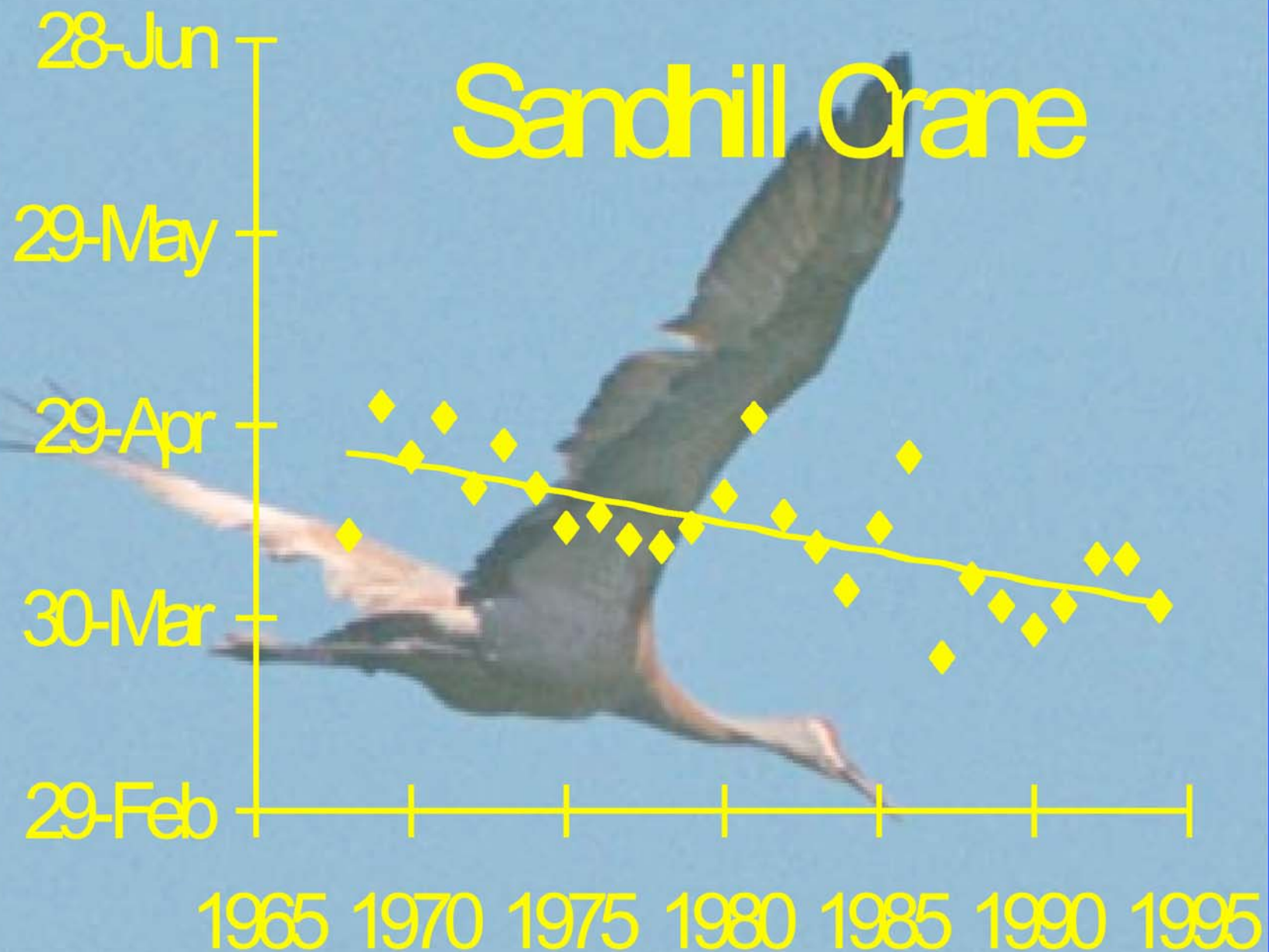
Type of Changes

CA Fish: California
Golden Trout
Phenology Shift

www.fisheyeguyphotography.com



Sandhill Crane



Sandhill Crane

www.birdperch.com

Meta- Analysis:

Spring Phenology

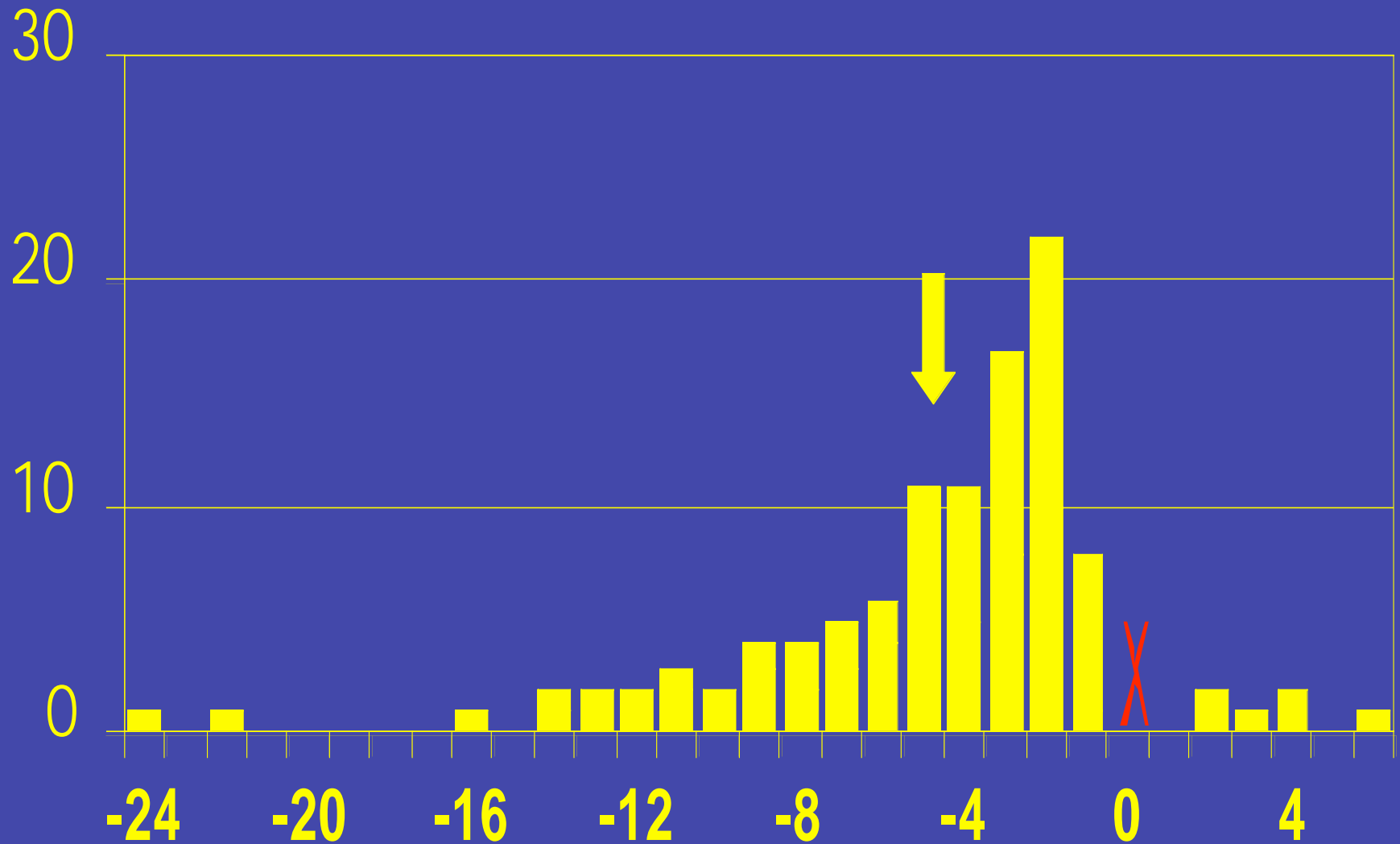
61 Studies

694+ Species

CA Animal: California Grizzly Bear



Frequency of Species



Number of Days Changed in 10 Years



Global Meta-Analysis

143 Studies

1473+ Species

All Changes:

**1473+
Species
Changed**

~20% (277+) Opposite

~80% (1196+) As Expected

CA Marine Fish: Garibaldi



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Human Interference in the Extinction of the CA State Fossil Species of Extinct Tiger



Hierarchy of Actions for Different Levels of Concern:

- Monitor for Declines



CA Marine Mammal: Gray Whale

- Continue Managing

- Managed Relocation

- Out of Our Direct Control

Monitor



Continue Managing and Monitoring

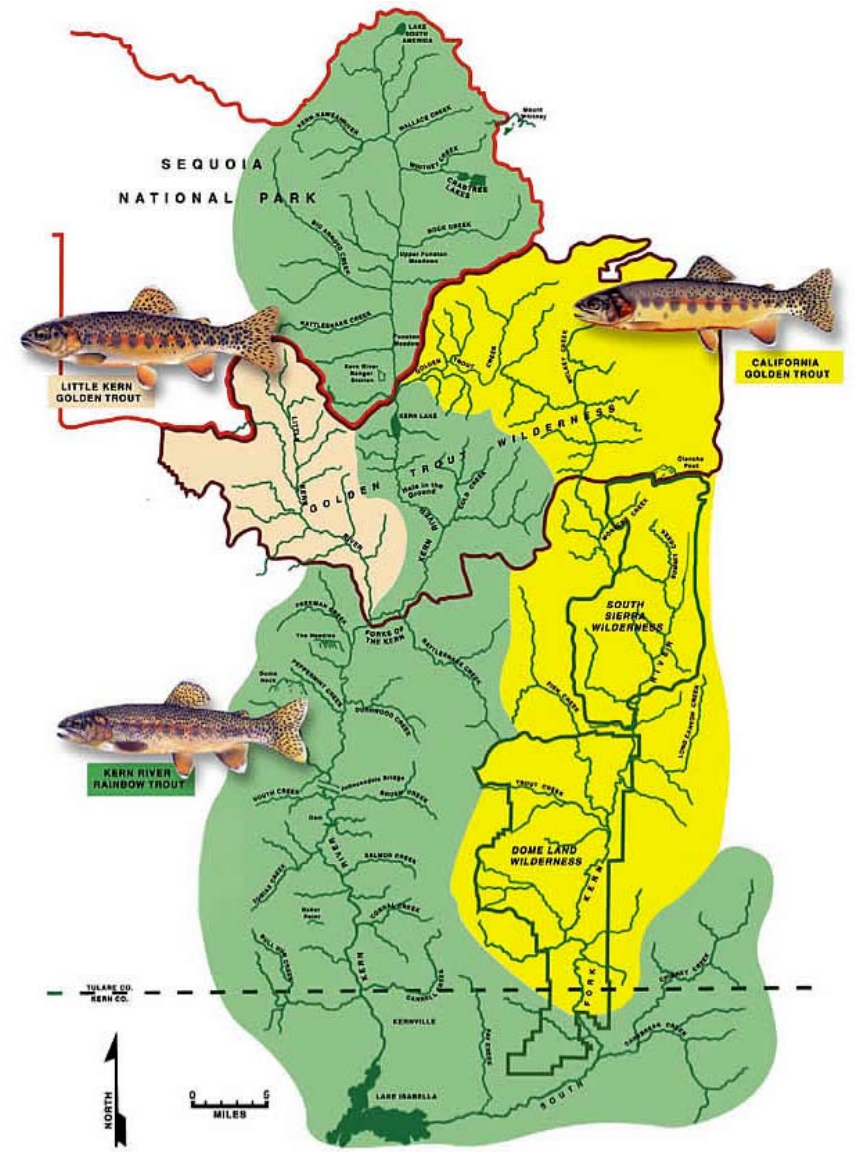
CA Reptile: Desert Tortoise



Percent of Locations Losing ALL Trout Habitat

| | Days Trout Fishing in Streams (1996) | Trout Sites/ Total Sites | 2030 | 2060 | 2090 |
|-------------------|--|-----------------------------------|------------|-------------|-------------|
| CA | 5,200,000 | 110/ 215 | 4 - 20% | 22 - 32% | 33 - 60% |
| US A (- AK) | 49,400,000 | 791/ 2050 | 7 - 14% | 13 - 26% | 18 - 38% |

Managing and Monitoring



www.fisheyeguyphotography.com



Actions for Different Levels of Concern:

- Monitor for Declines



- Traditionally Managed

- Managed Relocation

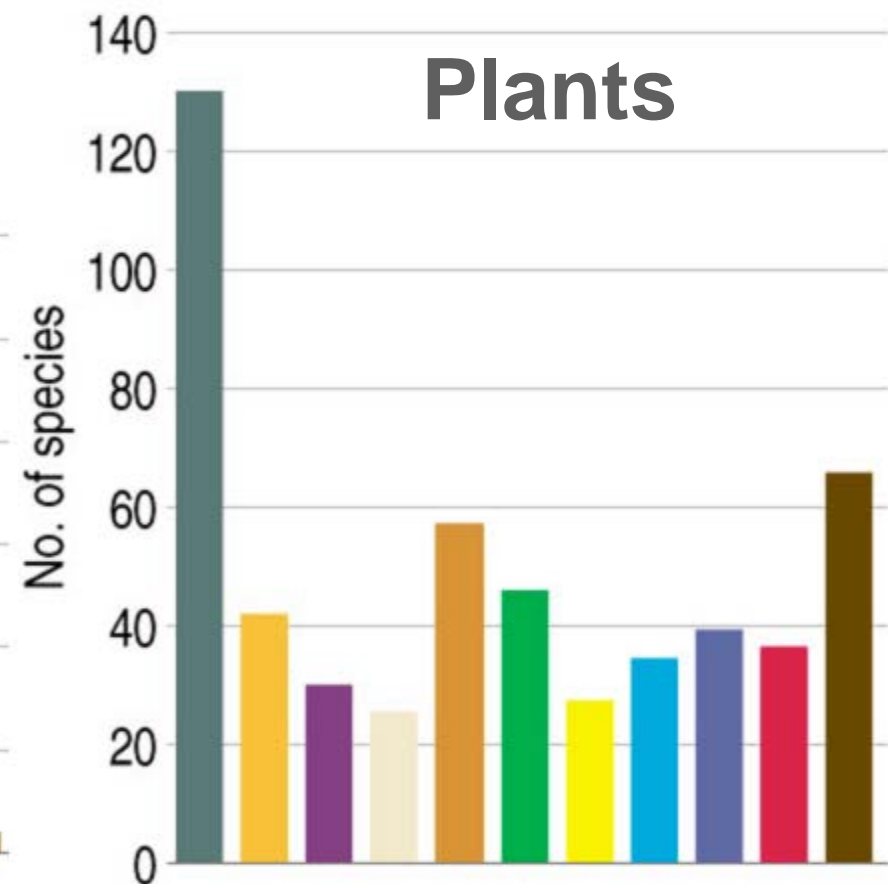
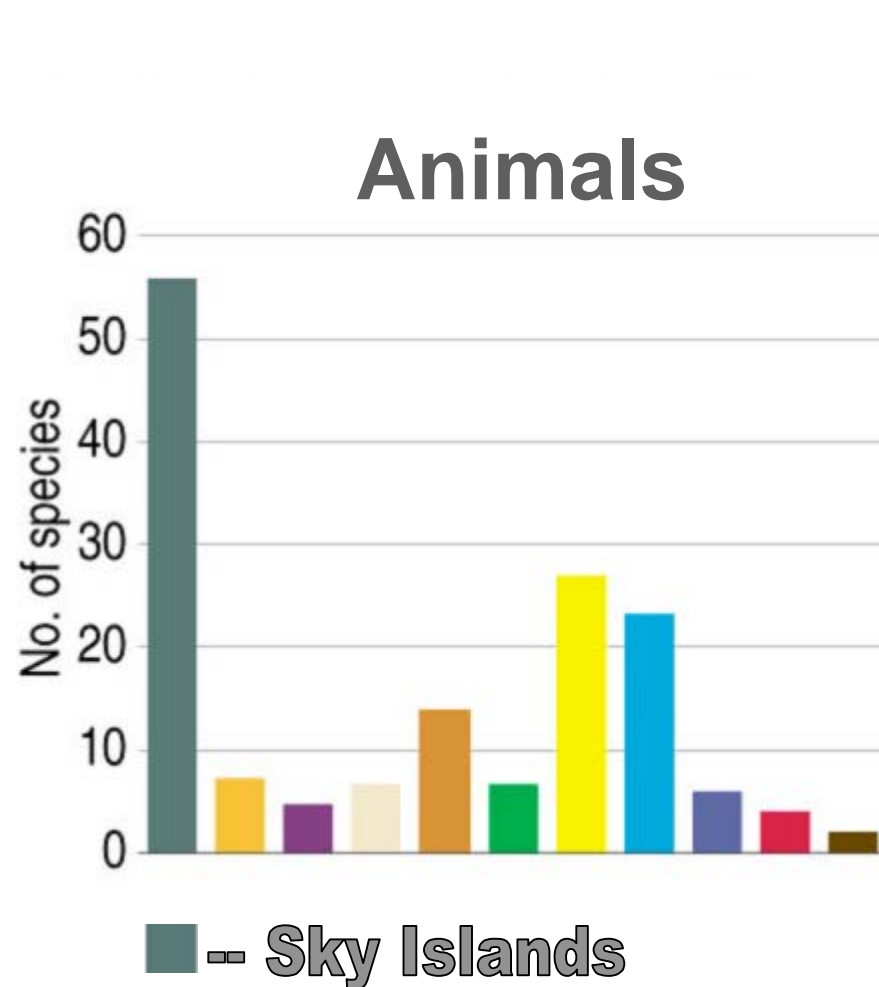
- Out of Our Direct Control

Habitat Islands

- ◆ Sky Islands in NM & AZ
 - Managed Relocations
 - Continue Managing & Monitoring



Threatened, Endangered & Sensitive Species in SW National Forests



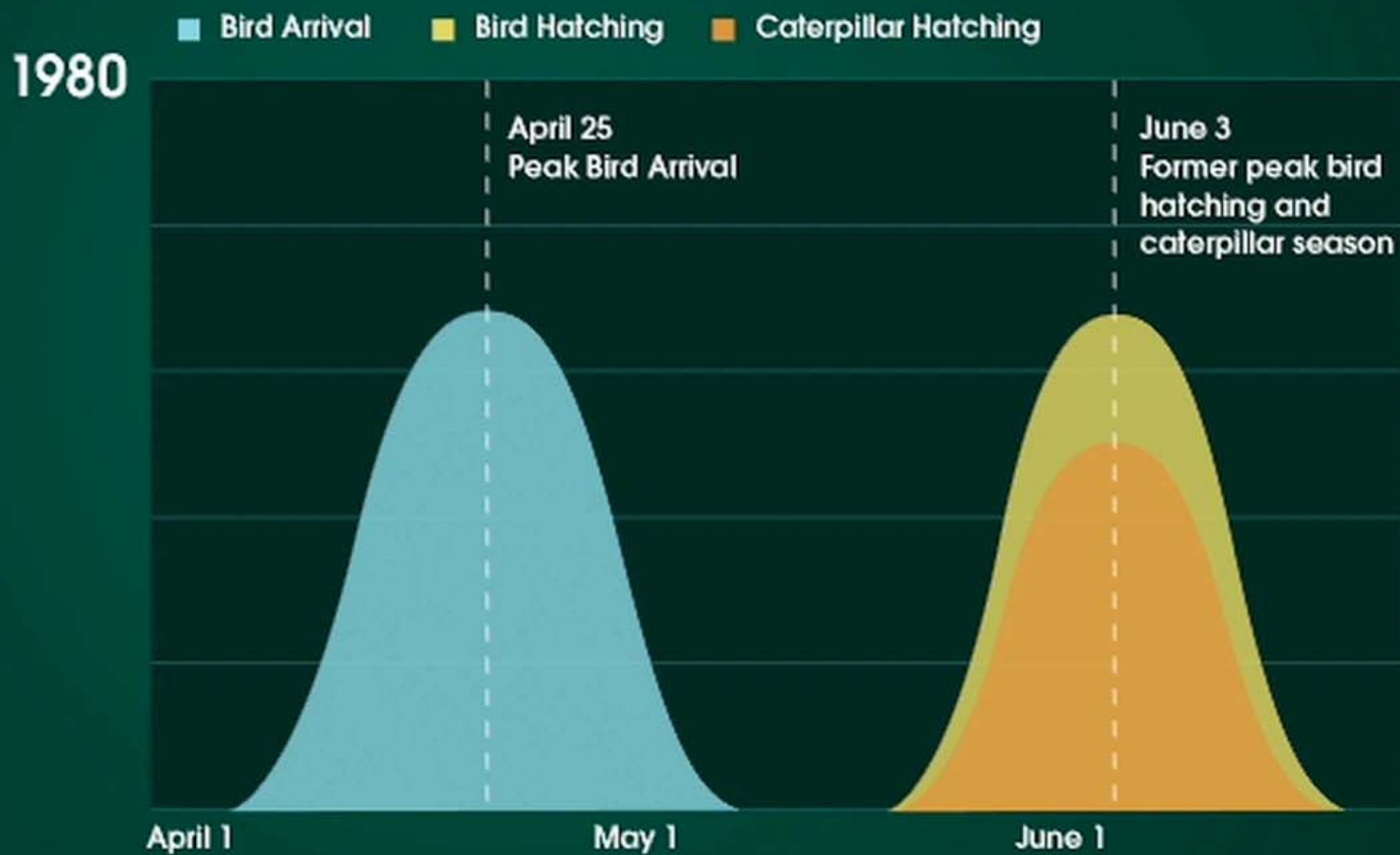
Tearing Apart of Communities

CA State Flower: Golden Poppy

- Disrupting Biotic Interactions
- Managed Relocation
- Extinction



Shifts in Seasons



Synergistic Affects



1975



2001



Edith's Bay Checkerspot



Obstacles:

Money

Political Power

Will Power

People Power

Space

Infrastructure

Invasive Species

Actions for Different Levels of Concern:

- Monitor for Declines

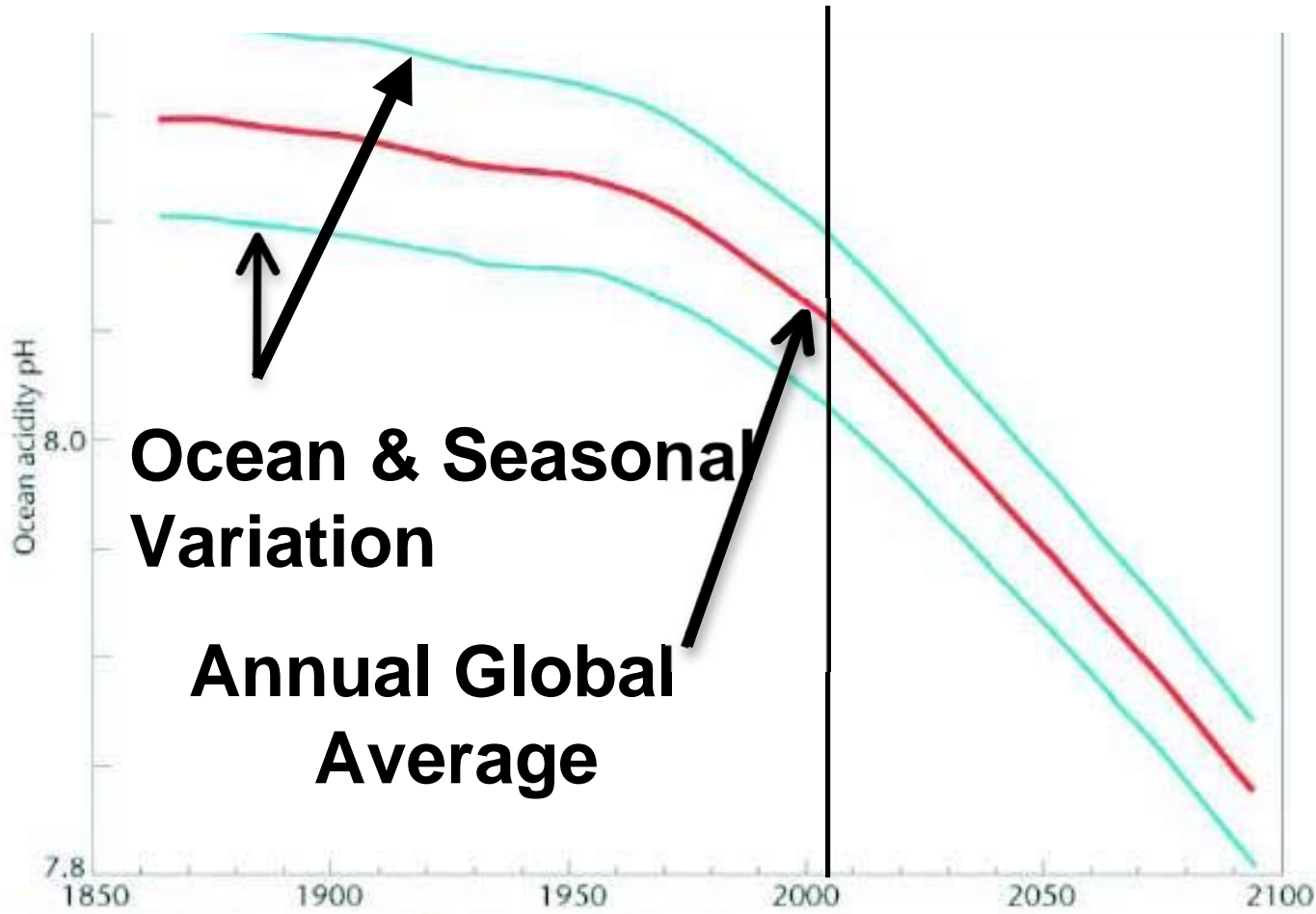


- Traditionally Managed

- Managed Relocation

- Out of Our Direct Control

Ocean Acidification



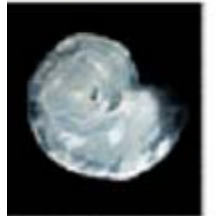
Hadley Centre for Climate Prediction and Research



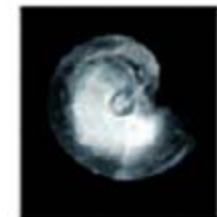
Day 1



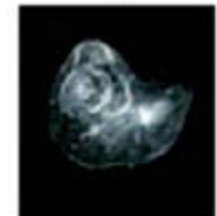
Day 2



Day 16

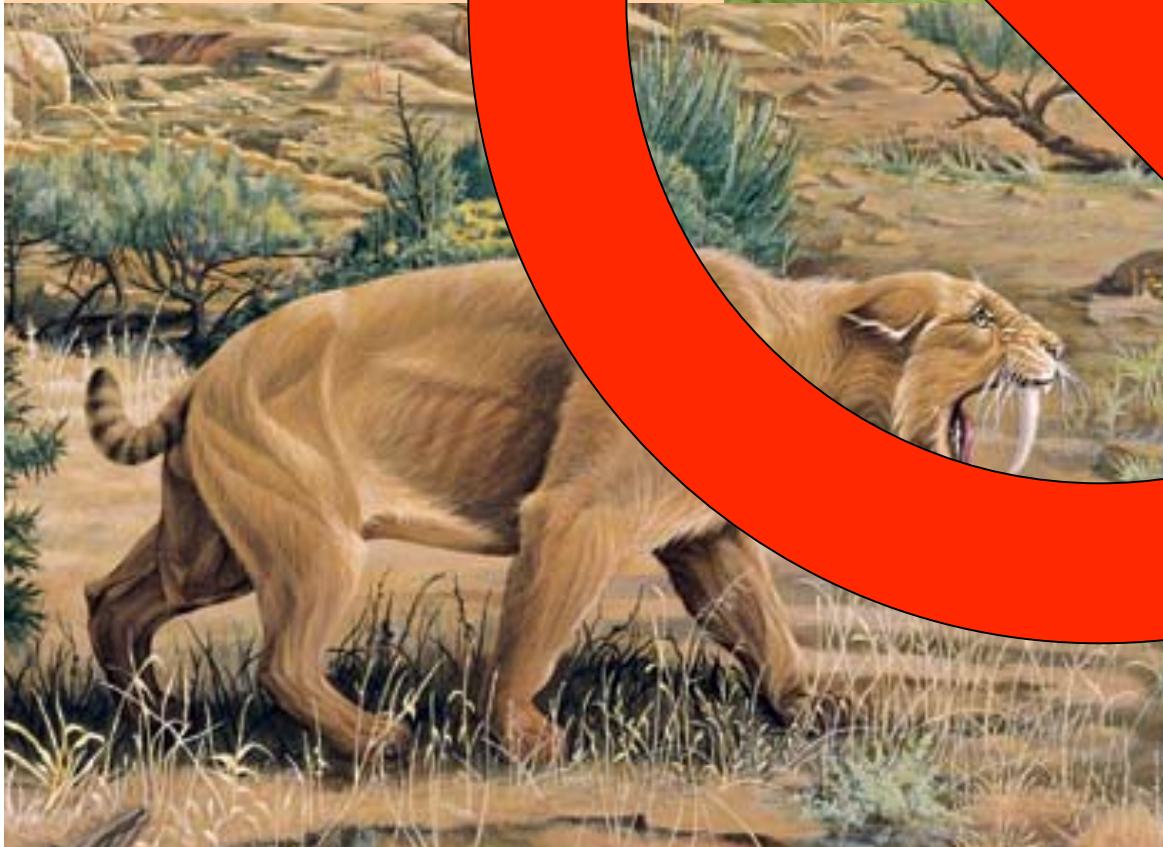


Day 26



Day 45

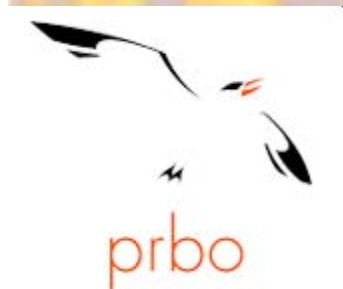
California
Grizzly Bear



Sabertooth
Tiger

Wait for Speciation





Guido Franco



California Species

| Species | Number | % at Risk |
|--------------------|--------|-----------|
| Total | 6717 | 28% |
| Endemic | 1295 | -- |
| Extinct | 53 | -- |
| Plants | 5418 | 30% |
| Mammals | 195 | 16% |
| Birds | 415 | 5% |
| Reptiles | 86 | 16% |
| Amphibians | 57 | 49% |
| Freshwater Fish | 62 | 50% |

CA Dogfaced Butterfly

